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Prevalence of Musculoskeletal Pain and Its Association with Computer Workstation Ergonomics among Undergraduates in Malaysia

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Abstract

Background: Advanced technology promotes students to utilize computers widely for educational purposes, leading to increased musculoskeletal (MSK) pain among undergraduates. This study aimed to identify the prevalence of various MSK pain and its association with computer workstation ergonomics among undergraduates in Malaysia. **Method**: A cross-sectional study was conducted using a self-administered online questionnaire among 390 undergraduates. Data on Nordic Musculoskeletal Questionnaire and Computer Workstation Checklist were collected. Descriptive statistics were used to evaluate the prevalence of MSK pain and its association with computer workstation ergonomics was analysed using the chi-square test. **Results**: 79.1% and 52.7% of the participants reported MSK pain in the past 12 months and 7 days respectively. This study also revealed that pain in the neck, elbow, wrist, lower back, hip, knee, and ankle in the past 12 months were associated with the computer workstation ergonomics, namely the height of the armrest, keyboard, and input device, monitor's viewing distance and level, the usage of a comfortable keyboard, comfortable input device and document holder, with $p<0.05$. Whilst pain in the neck, wrist, and knee in the past 7 days were associated with the chair seat width, monitor's distance and height, obstruction under the table, and usage of document holder, with $p<0.05$. **Conclusion**: This study revealed that more than half of the undergraduates have experienced MSK pain and there is an association with computer workstation ergonomics. Therefore, undergraduates should be educated on the proper computer workstation ergonomics as a preventive measure for MSK pain.

Keywords

Musculoskeletal pain, Nordic Musculoskeletal Questionnaire, Computer Workstation Checklist, Computer workstation ergonomic

Introduction

With the progress of the present age and the development of science and technology, the use of computers and mobile devices has become a necessity in people's everyday lives. Furthermore, the widespread Covid-19 has led to digital technologies surge due to lockdowns across various

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countries and social distancing norms (De et al., 2020). Advanced technology nowadays promotes students to use computers widely for educational purposes. It is undeniable that using computers helps improve productivity and efficiency. However, prolonged usage of the computer has brought impacts on the musculoskeletal system. It was found that work-related musculoskeletal (MSK) disorders extended equally with the rise in computer use (Wilkens, 2003). Musculoskeletal pain can be explained as pain aggravated that agitates the muscles, tendons, ligaments, bones, and nerves. Musculoskeletal conditions are often characterized by persistent pain, leading to limitations in mobility, skills, and overall level of functioning and reducing people's ability to work (World Health Organization, 2021).

Dockrell et al. (2015) found that 52.8% of undergraduate students developed computer-related MSK symptoms. MSK pain could be due to frequent and repetitive activities, with poor ergonomics, and was associated with posture and duration of computer use (Alshagga et al., 2013; Dockrell et al., 2015; Narsigan, 2015; Osama et al., 2018). However, the impact of ergonomic interventions on computer users is still under dispute. Therefore, proper ergonomic assessment of workstation design should be assessed among undergraduate students to enhance a better understanding of the prevalence of MSK pain in relation to computer workstation ergonomics. It could also help to ensure proper ergonomics could be followed and cultivated among undergraduate students. Hence, this study is aimed at identifying the prevalence of various MSK pain and its association with computer workstation ergonomic setup among undergraduates in Malaysia.

Methodology

This cross-sectional study was conducted among undergraduates in Malaysia. They were recruited by convenience sampling via social media platforms. The target population of this study was full-time university undergraduate students in Malaysia regardless of gender who are 18 to 25 years old. Participants who took part-time university academic programs, with congenital anomalies, and were diagnosed with musculoskeletal disorders such as cervical spondylosis, spondylolisthesis, spondylolysis, or amputated were excluded. The ethics approval was obtained from the Research and Ethic committee of INTI International University (reference no: INTI-IU/FHLS-RC/BPHTI/7NY12021/011).

Nordic Musculoskeletal Questionnaire (NMQ) was used to determine the prevalence of MSK pain in the past 12 months and 7 days in the body parts and is applicable to evaluate MSK problems for a wide range of occupations including computer workers (Crawford, 2007). The reliability and validity of the NMQ were discussed by Kuorinka et al. (1987). Computer Workstation Checklist (CWC) is a self-reported checklist to assess the computer workstation. It consisted of 16 diagnostic questions related to a chair, keyboard, input, monitor, computer table, and document holder with 'Yes' and 'No' choices provided which indicated the involvement of the component in the computer workstation. Baker et al. (2013) reported that the CWC had high reliability and the 16 diagnostic questions ranged from fair to near perfect with Prevalence-Adjusted Bias Adjusted Kappa (PABAK) score of 0.38-0.93 and the positive predictive value was greater for all 16 questions. A score greater than or equal to 0.90 was used as an indicator of

excellent validity. 3 out of the 16 diagnostic questions met the criteria for sensitivity, while 11 of the 16 questions met it for specificity.

Statistic package SPSS Version 21 was used for data analysis. Descriptive analyses were applied to investigate all the categorical variables. The Chi-square test was then applied separately to find the association between musculoskeletal discomfort in the nine body parts and participants' characteristics, computer usage, and characteristics of computer workstations.

Results

A total of 390 participants were included in this study based on the inclusion and exclusion criteria. Most of the participants were female (66.4%) and older than 21 years old (76.2%). 61% of the participants had a normal BMI. 45.6% of the participants were year 4 students, followed by year 3 students (26.9%). 83.8% of the participants used a laptop while 16.2% were using either a desktop or a tablet. 43.1% of the participants spent 5-8 hours on the computer workstation, while 24.9% of the participants spent 1-4 hours, followed by 23.6% with 9-12 hours, and 8.5 % of them using the computer for more than 12 hours. Concerning break duration while using the computer, 10.3% of the participants did not take any break while 44.1% of the participants took 15-45 minutes break. More than 52.3% of the participants performed stretches while using the computer. The descriptive analysis of demographic data is displayed in Table 1.

Table 1. Descriptive analysis related to demographic data (N=390).

Variables	**n**	**%**
Age (years), n (%)		
≤21	93	23.8
>21	297	76.2
BMI (kg/m^2)		
Underweight	91	23.3
Normal	238	61.0
Overweight and obese	61	15.6

BMI: Body Mass Index

The prevalence of MSK pain in the previous 12 months was higher than that in the past 7 days with 79.1% and 52.7% respectively. The highest number of participants who reported pain in the previous 12 months and 7 days was in the neck (58.8% and 53.9%), followed by the shoulder (58.5% and 47.5%), and lower back (53.3% and 39.7%) as displayed in Figure 1.

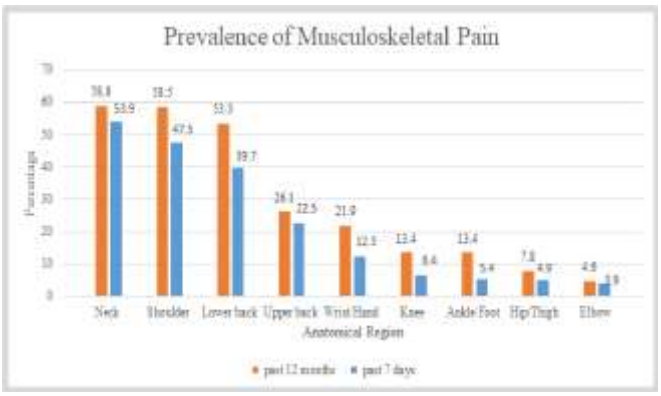

Figure 1. Prevalence of Musculoskeletal Pain among undergraduates in different anatomical regions in the past 12 months and 7 days.

11 out of 16 components of the CWC were adopted by more than 50% of undergraduates in their computer workstations except for seat depth, backrest supporting the entire back, armrest height, keyboard height, and using a document holder. Those who performed stretch breaks (15.3%) were more likely to have upper back pain ($\chi2=4.831$, $p=0.028$) in the past 7 days compared to those who did not (8.1%). Shoulder pain was found to have no association with any component in the CWC despite it being the second-highest prevalence in the current study. For the pain in the past 7 days, neck pain was found significantly associated with the distance from the eyes to the monitor ($\chi2=6.912$, $p=0.009$) and the monitor position level ($\chi2=5.904$, $p=0.0015$) (Table 2). Wrist pain was found associated with obstructions under the computer table ($\chi2=6.016$, $p=0.014$) and usage of the document folder ($\chi2=4.743$, $p=0.029$). Besides, knee pain was significantly associated with the chair seat width ($\chi2=6.550$, $p=0.01$).

For the pain in the past 12 months, pain or discomfort in the neck was found significantly associated with the comfortability level of the keyboard ($\chi2=5.061$, $p=0.024$) and height of the input device ($\chi2=6.227$, $p=0.013$) (Table 3). While elbow pain was significantly associated with the comfortability level of the input device ($\chi2=7.060$, $p=0.008$) and the viewing distance between the monitor screen and eyes ($\chi2=4.677$, $p=0.031$). The wrist or hand was found significantly associated with the comfortability level of the keyboard ($\chi2=9.380$, $p=0.002$) and the height of the input device ($\chi2=6.692$, $p=0.010$). Lower back pain was found significantly associated with the monitor position level ($\chi2=6.126$, $p=0.013$) while hip pain was associated with the height of the keyboard ($\chi2=6.267$, $p=0.012$), knee pain was associated with the usage of document holder ($\chi2=5.696$, $p=0.017$), and ankle or foot pain was associated with armrest height ($\chi2=4.830$, $p=0.028$).

Table 2. Association of computer workstation checklist with the prevalence of MSK pain in the past 7 days using chi-square test.

Computer workstation checklist		Prevalence of Pain in the past 7 days				
		Yes n (%)	No n (%)	Total	χ2	P-value
Neck pain						
Distance from eyes to the monitor screen	**Yes**	72 (24.9)	217 (75.1)	289	6.912	**0.009***
	No	38 (38.8)	60 (61.2)	98		
Monitor position	**Yes**	65 (24.6)	199 (75.4)	264	5.904	**0.015***
	No	45 (36.6)	78 (63.4)	123		
Wrist/ Hand pain						
Under computer table obstruction removed	**Yes**	11 (4.3)	246 (95.7)	257	6.016	**0.014***
	No	14 (10.8)	116 (89.2)	130		
Use of document holder	**Yes**	13 (10.4)	112 (89.6)	125	4.743	**0.029***
	No	12 (4.6)	250 (95.4)	262		
Knee pain						
Chair seat with comfortable width	**Yes**	6 (2.0)	288 (98.0)	294	6.550	**0.010***
	No	7 (7.5)	86 (92.5)	93		

Chi-Square Test was used. χ2= Pearson's chi square test. *p-value = <0.05

Table 3: Association of computer workstation checklist with the prevalence of MSK pain in the past 12 months using chi-square test

Computer workstation checklist		Prevalence of Pain in the past 12 months				
		Yes n (%)	No n (%)	Total	χ2	P-value
Neck pain						
Keyboard comfortability	**Yes**	141 (43.9)	180 (56.1)	321	5.061	**0.024***
	No	39 (59.1)	27 (40.9)	66		
Height of the input device	**Yes**	94 (41.2)	134 (58.8)	228	6.227	**0.013***
	No	86 (54.1)	73 (45.9)	159		
Elbow pain						
Input device comfortability	**Yes**	8 (2.5)	314 (97.5)	322	7.060	**0.008***
	No	6 (9.2)	59 (90.8)	65		
Distance from eyes to the monitor screen	**Yes**	7 (2.4)	282 (97.6)	289	4.677	**0.031***
	No	7(7.1)	91 (92.9)	98		
Wrist/ Hand pain						
Keyboard comfortability	**Yes**	47 (14.6)	274 (85.4)	321	9.380	**0.002***
	No	20 (30.3)	46 (69.7)	66		
Height of the input device	**Yes**	30 (13.2)	198 (86.8)	228	6.692	**0.010***
	No	37 (23.3)	122 (76.7)	159		

Lower back pain						
Position of the monitor	**Yes**	100 (37.9)	164 (62.1)	264	6.126	**0.013***
	No	63 (51.2)	60 (48.8)	123		
Hip/Thigh Pain						
Height of keyboard	**Yes**	5 (2.8)	171 (97.2)	176	6.267	**0.012***
	No	19 (9.0)	192 (91.0)	211		
Knee pain						
Use of document holder	**Yes**	20 (16.0)	105 (84.0)	125	5.696	**0.017***
	No	21 (8.0)	241 (92.0)	262		
Ankle/Foot pain						
Armrest height	**Yes**	10 (6.4)	146 (93.6)	156	4.830	**0.028***
	No	31 (13.4)	200 (86.6)	231		

Chi-Square Test was used. $\chi 2$= Pearson's chi square test. *p-value = <0.05

Discussion

This study showed that more than half of the undergraduates in Malaysia experienced MSK pain in the past 12 months and 7 days with similar findings reported by several other studies (Alshagga et al.,2013; Dockrell et al., 2015; Jenkins et al., 2007; Katz et al., 2000). In the current study, the prevalence of MSK pain was higher with the possibility of increased usage of computers for online classes.

Pain or discomfort in the neck, shoulder, and lower back in both 12 months and 7 days was supported by the studies of Casas S et al. (2016) and Osama et al. (2018). Shoulder muscle activation increased when the forearm is placed higher than the resting elbow height (Zhu & Shin, 2011). Eggleston (2020) also stated that a keyboard or mouse placed at a height above a relaxed elbow height would lead to kyphotic posture and increase the contact stress over the wrist joint on the workstation surface. Besides, it might be due to overactivation of the trapezius muscle when the input device was placed higher than the elbow height. Moreover, armrest height was found associated with MSK pain in the lower back and ankle or foot pain as a result of a compensatory mechanism leading to the re-distribution of the body weight and forces on other areas. The keyboard and input device were advised to be placed in a posture that supports the users to maintain an upright seated position while the elbow rest at the side of the body with the forearm placed horizontally as the keyboard or mouse (Department of Occupational Safety and Health, 2003).

Pain or discomfort in the neck in the past 7 days was found associated with the viewing distance between the monitor screen and eyes and the monitor position level which was similar to previous studies (Basakci Calik et al., 2020; Kanchanomai et al., 2011; Mowatt et al., 2018), where those who did not fix the appropriate monitor ergonomic setup were more likely to have pain in the neck region. The monitor viewing distance contributing to elbow pain occurred most in laptop users as the keyboard was attached to the laptop. Hence, increased pressure on the elbow. Lower back pain in the past 12 months was found significantly associated with the monitor position level,

which was contrasted with Basakci Calik et al. (2020) study. The author concluded that inappropriate posture in cervical and thoracolumbar regions among office workers did not adversely affect pain in the lower back. However, when the computer was positioned below eye level, the users would have to bend forward to read. Therefore, leading to pain.

Other contributing factors such as the type of breaks and type of stretching performed were not investigated. Therefore, observational method assessment on computer workstation ergonomics and setups such as Rapid Upper Limb Assessment (RULA) or ROSA (Rapid Office Strain Assessment) could be adapted in future studies to obtain more accurate data on the interaction among sitting posture, and ergonomic setup in the computer workstation.

Conclusion

This study revealed that more than half of the undergraduates have experienced MSK pain, with the highest prevalence of pain reported at the neck. Besides, this study found that pains in the neck, elbow, wrist, lower back, hip, knee, and ankle in the past 12 months and 7 days were significantly associated with the computer workstation ergonomics. This study indicates more than half of the undergraduates adopted some ergonomic setup in their computer workstations. Therefore, it is important to educate undergraduates on the proper computer workstation ergonomics as a preventive measure for MSK pain.

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References

Alshagga, M. A., Nimer, A. R., Yan, L. P., Ibrahim, I. A. A., Al-Ghamdi, S. S., & Radman Al-Dubai, S. A. (2013). Prevalence and factors associated with neck, shoulder and low back pains among medical students in a Malaysian Medical College. BMC Research Notes, 6(1), 244.

Baker, N. A., Livengood, H., & Jacobs, K. (2013). Reliability and concurrent validity of the computer workstation checklist. Work, 45(2), 213–221.

Basakci Calik, B., Yagci, N., Oztop, M., & Caglar, D. (2020). Effects of risk factors related to computer use on musculoskeletal pain in office workers. International Journal of Occupational Safety and Ergonomics, 0(0), 1–6.

Casas S, A. S., Patiño S, M. S., & Camargo L, D. M. (2016). Association between the sitting posture and back pain in college students. Revista de La Universidad Industrial de Santnader. Salud, 48(4), 446–454.

Crawford, J. O. (2007). The Nordic Musculoskeletal Questionnaire. Occupational Medicine, 57(4), 300–301.

De, R., Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. International Journal of Information and Learning Technology, 55, 1–6.

Dockrell, S., Bennett, K., & Culleton-Quinn, E. (2015). Computer use and musculoskeletal symptoms among undergraduate university students. Computers and Education, 85, 102–109.

Department of Occupational Safety and Health. (2003). Guidelines on Occupational Safety and Health for Working with Video Display Units. In *Applied Ergonomics* (Vol. 62, Issue 1). http://dx.doi.org/10.1016/j.apergo.2016.10.015%0Ahttps://doi.org/10.1016/j.apergo.2019.05.004%0Ahttps://software.intel.com/en-us/articles/guidelines-for-immersive-virtual-reality-experiences%0Ahttp://dx.doi.org/10.1016/j.procir.2016.02.084%0Ahttps://doi.o

Eggleston, S. T. (2020). Mouse with your armTM: Facilitating forearm support using the chair armrest to prevent and mitigate musculoskeletal disorders. Work, 65(3), 483–495.

Jenkins M, et al. Undergraduate college students' upper extremity symptoms and functional limitations related to computer use: A replicated study. Work 2007, 28(3), 231–8.

Kanchanomai, S., Janwantanakul, P., Pensri, P., & Jiamjarasrangsi, W. (2011). Risk factors of the onset and persistence of neck pain in undergraduate students: 1-year prospective cohort study. BMC Public Health, 11, 566.

Katz, J. N., Amick, B. C., Carroll, B. B., Hollis, C., Fossel, A. H., & Coley, C. M. (2000). Prevalence of upper extremity musculoskeletal disorders in college students. American Journal of Medicine, 109(7), 586–588.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jørgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Applied Ergonomics, 18(3), 233–237.

Mowatt, L., Gordon, C., Santosh, A. B. R., & Jones, T. (2018). Computer vision syndrome and ergonomic practices among undergraduate university students. International Journal of Clinical Practice, 72(1).

Narsigan S, E. T. (2015). The Association of Unsound Sitting Posture and Vertebral Musculoskeletal Pain among University Administrators. Journal of Ergonomics, s4, 10–12.

Osama, M., Ali, S., & Malik, R. J. (2018). Posture related musculoskeletal discomfort and its association with computer use among university students. Journal of the Pakistan Medical Association, 68(4), 639–641.

Wilkens, P. M. (2003). Preventing work-related musculoskeletal disorders in VDT users: A comprehensive health promotion program. Work, 20, 171-178.

World Health Organization. (2021). Musculoskeletal Health. *World Health Organization.* https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

Zhu, X., & Shin, G. (2011). Effects of armrest height on the neck and shoulder muscle activity in keyboard typing. Proceedings of the Human Factors and Ergonomics Society, 958–962.